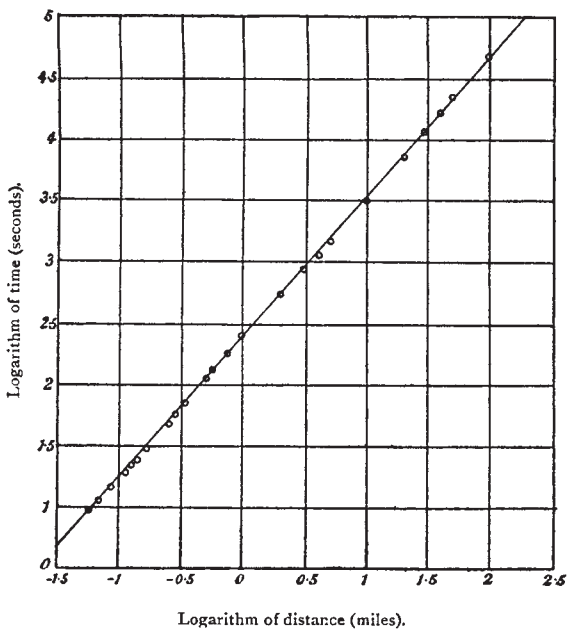
where n is a constant and A varies with the animal and the mode of progress. That is, in terms of logarithms,

$$\log T = \log A + n.\log L \quad . \quad . \quad . \quad . \quad (2)$$

Hence, if T and L are plotted on logarithmic paper, or their logarithms plotted on ordinary scale paper, the points obtained will lie more or less closely round a straight line. If a line be run as near as may be through the points, its slope will give the value of n. This is the procedure adopted by Mr. Kennelly, and he finds an average value of n equal to 9/8, corresponding to a ratio of the times for double distances 2·181. To illustrate the closeness of the logarithmic law from data that are readily accessible in England, we have plotted a diagram from the table of running records in "Whitaker's Almanack" (p. 415), taking, like Mr. Kennelly, the lowest record, whether amateur or professional, in each case. We must refer the reader to the original paper for numerous diagrams, on a somewhat larger scale, illustrating the records in the other cases.

The author concludes, we think correctly, that a



Men running: logarithmic graph of record time and distance, 100 yards to 100 miles.

record is more likely to be lowered if it correspond to a point lying above the time-distance line than if it correspond to a point lying below it, and hence the graph may be of service to the athlete. He also argues that, as a consequence of the law, an athlete should adopt such a speed in running that he can just maintain it constant to the end of the course and is then completely exhausted. But the energy of the individual is not exhausted suddenly in this way, and, although the conclusion may concur with practice, we do not think that it follows from the given law of record speeds. We agree with the author that more information is wanted on this head. It seems doubtful, in fact, if the observed rule should be termed a "law of fatigue" at all; it is not a law of the variation of speed, with time or distance, for the same individual running his fastest continuously, nor even of the average speeds of the same runner over different distances when he knew in advance the distance to be run. It is a law relating times to distances when the best possible runner is selected for each particular distance. This involves the adaptation of the individual as well as fatigue. How much it involves adaptation or selection is illustrated by the complete disagreement of the older with the more recent records for the case of trotting horses. For the longer distances only old records are available, and these fit much better with the older records for short distances (cf. *Encycl. Brit.*, xii., 205) than with the more recent records given by Mr. Kennelly.

We cannot help hoping that a knowledge of "Kennelly's Law" will soon be widely diffused; the possibilities of its educational influence seem almost unbounded. The bookmakers will take to studying "Chambers' Tables"; betting books will be bound up with a few pages of logarithmic paper for the purpose of entering, shall we say, "recordograms"; and Jones Minor, callous to the beauties of logarithmic graphs when illustrated by the laws of steam or the behaviour of purely symbolic barges on non-existent canals, may awaken into something resembling life when racing records are in question. Schoolmasters need not hesitate for fear of corrupting youth; the necessary data can be taken from either of those most respectable publications, "Whitaker's Almanac" and the "Encyclopædia Britannica."

G. U. Y.

PROF. H. W. BAKHUIS-ROOZEBOOM.

CHEMISTS have received with great sorrow the news of the death of Prof. H. W. Bakhuis-Roozeboom on February 8. Roozeboom was struck down in full activity, and science might have hoped to have been enriched by his work for years to come. At the beginning of February, however, he was attacked by influenza; apparent recovery was followed by pneumonia, which in three days proved fatal. He leaves a widow and five children.

Hendrik Willem Bakhuis-Roozeboom was born on October 24, 1854, at Alkmaar, a little town some twenty miles north of Haarlem, noted in history for the first successful resistance made against the Spaniards in the struggle for Dutch independence. He was educated in his native town at one of the higher burgher schools where so excellent an education on modern lines is given. Even during his school career his unusual ability gave promise of a notable future. After leaving school he assisted his chemistry master, Dr. Boeke, for some time in making a number of soil analyses in connection with the plan which is still under discussion of draining the neighbouring Zuider Zee. Not thinking at first of an academic career, he accepted a position in the butter factory of Dr. Mouton at the Hague, and it was the circumstance of the factory being burnt down in 1878 which decided his future. Hearing of the fire, a brother-in-law of Dr. Boeke, van Bemmelen, professor of chemistry at Leyden, offered Roozeboom the post of assistant. This he decided to accept, and while thus occupied he carried on his studies in the University of Leyden, and graduated in 1884. He remained at Leyden as docent, and later as lecturer, supplementing his small university stipend by teaching in the girls' higher burgher school and by translating English books into Dutch, until on the removal of van 't Hoff to Berlin in 1896 he succeeded him as professor of general chemistry in the Uni-

versity of Amsterdam, and this chair he held until the time of his death.

In the Dutch universities seven years is the minimum period of study required for graduation, and the last of these is devoted to original research. The work undertaken by Roozeboom on the hydrates of the halogens and their hydrides led him at once to the problems with which his name will always be associated.

In the course of his experiments he came upon phenomena which he was unable to explain. At that time the conditions which determine equilibrium in chemical systems were little understood by chemists. About ten years before, the American physicist, Willard Gibbs, had developed a theory of equilibrium between materials in contact which was completely independent of all assumptions as to the nature of matter or as to molecular structure. Given a system constituted of homogeneous portions (phases, as they are called, P in number) separated from each other by definite surfaces of contact, and made up of constituents (components, as they are termed, C in number) the amounts of which present in the system can alter independently of the others, Gibbs had shown that, considering only the temperature and pressure under which the system exists and the concentration of the components, the number F of the latter conditions (degrees of freedom, as they are called) to which arbitrary values must be assigned to describe the system perfectly are given by the expression $F=C-P+2$, this numerical relationship being known as the "phase rule."

Gibbs had published his results in a journal not widely circulated—the Transactions of the Connecticut Academy. They were, moreover, presented in a mathematical form unfamiliar to chemists, and had consequently remained scarcely noticed all these years. Prof. van der Waals, to whom Gibbs's work was known, hearing of Roozeboom's difficulty, suggested to him that this mode of regarding equilibrium might throw light upon it. Roozeboom's philosophical mind at once grasped the immense possibilities of this new method of regarding problems of equilibrium, and from that time he occupied himself with brilliant success in working out its application to chemistry.

The investigations of Roozeboom and of those whom he interested in this branch of physical chemistry have cleared up our ideas in a surprising way, and opened out fresh paths of inquiry in the attractive region which connects chemistry and physics. The great merit of first applying the phase rule in chemistry must be attributed to Roozeboom, and gives him a high place among the founders of the new chemistry.

An account of the many applications of the phase rule to chemical problems was written by Roozeboom in his well-known book "Die heterogenen Gleichgewichte vom Standpunkte der Phasenlehre," of which two parts only have yet appeared. He had prepared all the necessary material, and was about to begin writing the third and concluding part at the time of his death.

Apart from scientific work his life was uneventful. His simplicity of character and extreme desire to do justice to every fellow-worker won him the affection of all who came to know him well. In 1890 he was made a member of the Royal Academy of Science of Amsterdam. Totally devoid of any trace of the advertising spirit, he received fewer public honours than might have been expected to follow his notable achievements, and everyone must feel regret that the scientific world did not in his lifetime more adequately recognise his services. F. D. CHATTAWAY.

NOTES.

THERE is every likelihood that Lord Lister's eightieth birthday, on April 4, will be suitably celebrated by his friends and admirers. A committee is being formed, consisting of representatives of medicine and science, with a view to carry into effect a suggestion made, we learn from the *British Medical Journal*, by Dr. C. J. Martin, F.R.S., the director of the Lister Institute. Dr. Martin has proposed that the best form in which to convey to Lord Lister the admiration and regard of his fellow-workers and followers would be the re-publication of all his scientific papers, prefaced by a biography of Lister containing an account of the part he took in the development of present knowledge of infectious processes, and of his efforts to avoid wound infection, the successful result of which revolutionised surgery. Dr. Martin will be glad to receive at the Lister Institute, Chelsea Gardens, S.W., the names of persons who desire to participate in this happy idea.

Science announces that the Rumford medal of the American Academy of Arts and Sciences "for discoveries in light and heat" has been awarded to Prof. E. F. Nichols, of Columbia University.

THE death is announced, in his seventy-fifth year, of Sir Thomas Hanbury, K.C.V.O., at one time of Shanghai, the founder of the Hanbury Botanical Institute at the Royal University, Genoa, and of the Museum Præhistoricum, near Mentone.

WE learn from the *Athenaeum* that the third congress of the Prehistoric Society of France will be held at Autun on August 13–18. Excursions will be made to Mâcon, to Mont-Auxois (the ancient Alesia), to Mont-Beuvray (the ancient Bibracte), and to Solutré. Dr. Marcel Baudouin, 21 rue Linné, Paris, is the secretary.

PETITIONS in support of the Metric Weights and Measures Bill, which is down for second reading on March 22, are being signed by many public bodies and institutions throughout the country. Among the petitions already received by the Decimal Association for presentation to the House of Commons is one signed by the headmaster and the whole teaching staff of Eton College.

THE model of the Channel Tunnel which was on view at Caxton Hall, Westminster, during last week was well patronised, and the voting of those who have inspected it has resulted in a large majority in favour of the scheme. The model is well made in sections, which show clearly the positions of the proposed tunnels in the chalk and the direction of the strata. An interesting point is the very slight variation of level which occurs at this part of the Channel bed.

THE death is announced of Prof. Y. Y. Tswetkoff, of the Moscow Petroffsky Forestry Institute. Soon after finishing his studies at the St. Petersburg University he obtained the degree of Master of Mathematics by a dissertation on surfaces subject to change without rupture or bend of their component parts. In 1864 he was commissioned by the Department of Agriculture abroad, and on his return he became extraordinary professor of the Moscow Institute of Forestry and Agriculture. In 1873 he became professor of mathematics at the Lycée. He read lectures also on physics and meteorology, and his auditorium was always crowded. In 1885 he retired owing to illness. He was most generous in helping poor students and others, and only after his death was it found that he had given away several thousand roubles in this way.